25° N., 115° W., on the 24th, after which it seems to have diminished and disappeared. The last storm, beginning on the 26th, moved more northward, and, like the first two of the month, entered the Gulf of California and disappeared after the 29th.

Winds at Honolulu.—The prevailing wind direction at Honolulu continued from the east, with the maximum velocity of 25 miles an hour from the east on the 25th.

Fog.—The occurrence of fog on the north Pacific lessened appreciably in September along the northern routes, and was reported on only 1 to 4 days in any 5° square. The region of most frequent occurrence lay along the American coast between 30° and 50° N., with about 30 per cent of the days with fog between Point Conception and the mouth of the Columbia River.

The Moyle-Allen airplane flight over the northwestern Pacific.—On September 8, Don Moyle and Cecil A. Allen, of California, took off from Sabishiro Beach, Japan, 375 miles north of Tokyo, attempting a nonstop flight of 4,465 miles to Seattle. They were thereafter lost until it was learned 10 days later that they had been forced down by stormy weather, landing upon a remote island of the western Aleutians. After seven days, they hopped off for Siberia, landing on the 17th on the Kamchatka coast, 1,900 miles north-northeast of their starting point of the 8th. They later flew to Nome.

THE SILVERSANDAL TYPHOON, SEPTEMBER 1 TO 4, 1931

Abridged from a report submitted by Rev. MIGUEL SELGA, S. J., director of the Manila Weather Bureau

To pass from a gentle breeze into a whole gale in the short interval of two hours without any apparent sign of a brewing storm was the unusual experience on September 1, 1931, of the 3,693-ton motor ship *Silversandal*, of the Silver Line. In its voyage from Shanghai to Manila the motor ship encountered gentle easterly breezes down the China coast and the Formosa Channel on the last day of August and the early morning of the 1st day of September, with the barometer remaining stationary at 755.8 mm. for eight hours. The usual precursors of a typhoon, such as convergence of cirri, shifts of the wind, or unusual swell, were all absent. No typhoon warning had been issued by the near-by broadcasting stations of Pratas and Keelung.

According to the log book, at 4 a. m. on September 1, when the *Silversandal* was approaching the northern entrance of the Formosa Channel, a gentle breeze was blowing from the northeast. The weather was noted down as fine and clear by the officer of the deck. At 8 a. m. the wind had increased one point in force and shifted to east by north, while short-lived rain squalls gave indications of unsettled weather. Two hours later the storm was on and the wind had increased to gale force. At 10:50 a. m. the wind was blowing whole gale and the speed of the ship had to be reduced. The barometer dropped to 744.5 mm. at 11:30, with the wind from east by north, of hurricane force. The blast of the whistle of the ship was lost in the roar of the wind and could not be heard by the members of the crew. The rain was blinding and the visibility so low that one end of the ship could not be seen from the other. At noon the wind was from the east and had dropped from force 12 to force 10, and by 4 p. m. the wind had veered to south-southeast and decreased to force 5 while the barometer had risen to 752.3 with general improvement of weather conditions.

This typhoon must have originated west of southern Formosa and passed north of Pratas in its westward motion without affecting considerably the barometers of western Formosa and of Pratas. No definite information on the origin and violence of the storm could be secured until the *Silversandal* made the port of Manila and the officers and log book of the ship were consulted.

The disturbance moved westward unnoticed throughout the evening and night of September 1, but at 6 a. m. on September 2, there were evident signs of a typhoon approaching Hong Kong from the southeast. About noon the gale developed with surprising suddenness in the British colony and many native craft were caught unawares.

Two unusual features characterized the passage of this typhoon close to Hong Kong—the unsteadiness of the winds and the oscillations of pressure. The wind vane of Hong Kong Observatory is reported as having made five complete revolutions between 8 and 11 p. m. In the words of the director of the royal observatory, the barometer trace was the most remarkable ever recorded at the observatory, the pen oscillating rapidly to the extent of a tenth of an inch between 8 and 9 p. m. Lowest pressure was 739.9 mm. at 2:55 p. m., attended by wind rising to a velocity of 124 kilometers per hour in the maximum gust, but some hours later the wind rose suddenly again to high velocities between 8 and 10 p. m., reaching a maximum velocity of 151 kilometers per hour in a gust at 9 p. m.

The mean speed of progression of the typhoon from the west of southern Formosa to the Asiatic Continent was about 8.6 miles per hour. The weather maps of September 4 show the center of the typhoon filling up over Kwangsi Province.

TROPICAL STORMS OF SEPTEMBER, 1931, IN NORTH AMERICAN WATERS

By W. F. McDONALD

September was marked in American tropical waters by no less than seven storms. At least three of these storms reached full hurricane intensity, one of them becoming a major disaster. Tracks of three storms which moved across the Caribbean Sea are illustrated elsewhere in this issue, in connection with a special report on hurricane damage in Porto Rico, the only United States possession to suffer by a hurricane during the month.

The first cyclonic development of the month began north of the Virgin Islands on the 1st, and was of minor intensity. It moved westward during the next six days reaching the western end of Cuba where it recurved northeastward on the 7th. The only gales reported during the progress of this relatively mild disturbance were over Mona Passage on the 2d, but flooding rains which caused great damage and some loss of life in Porto Rico may be attributed to conditions attending this cyclone.

While the first disturbance was in progress, another was developing in the southeastern Caribbean Sea. It was first suspected not far from Barbados on the 6th. The third for the month was also arising almost simultaneously in the Pacific a short distance southeastward from Acapulco, Mexico, where the American steamship *Marian Otis Chandler* encountered a cyclonic gale on the 6th. Both of these disturbances developed into storms of relatively small diameter but of full hurricane intensity as they progressed during the succeeding week.

While these two hurricanes were in simultaneous progress, and approaching the peak of their intensity, the

fourth tropical storm of the month was getting under way over the northern portion of the Leeward Islands on the 9th, and this storm likewise developed full hurricane intensity in its life of approximately a week as it moved westward to lose itself finally over the highlands of central Mexico.

It is of considerable interest, and perhaps of some importance for future studies of hurricanes, to point out that the three storms just mentioned, all of which reached the intensity of severe hurricanes, appear to have developed full severity at about the same time. The first storm ravaged Belize, British Honduras, on the afternoon of September 10, but ships encountering it earlier did not find winds of hurricane force. The second was first encountered as a hurricane of force 12 in the entrance to the Gulf of California on the 11th, and the third passed San Juan with damaging severity about midnight of the 10th–11th. The first two of these storms were in existence for four or five days however, before they reached hurricane intensity, but the third appears to have developed its strength within 36 hours from the time when its presence was first suspected, although it is possible that this storm may have originated still earlier in the little-traveled regions northeast of the Leeward Islands.

That three widely separated storm movements should thus show almost simultaneous increase in intensity may, of course, be pure coincidence, but it is not outside the bounds of probability that some major influence was at work in the weather conditions over the 2,000-mile arc embraced by the equally spaced locations of storms over Porto Rico, the Gulf of Honduras, and the entrance to the Gulf of California. The fact is at least worth recording for possible future reference.

The history of these three hurricanes will now be discussed in some detail, taking each in its chronological order by date of origin. As stated above, the Belize hurricane appears to have originated over the Windward Islands about the 6th of the month. The first ship's report, establishing conclusively its nature as a pronounced cyclonic depression, comes from the American tanker *Geo. H. Jones* (Captain Cavileer) near latitude 15° N., longitude 70° W., about midnight of the 7th–8th, with the barometer dropping sharply from 29.8 to 29.6, and a gale of force 8. The progress of this disturbance continued steadily west-northwestward during the next two days, with a number of ships reporting barometric decreases and winds at times reaching force 10 to 11, but none experiencing conditions of full hurricane intensity, even on the morning of the 10th in the Gulf of Honduras, where shipping is relatively numerous.

The 10th of September is a festival date in Belize, British Honduras, and the populace was out in holiday mood on the afternoon of that day as the hurricane, still of small extent but of ferocious intensity, moved in upon the town. It raged throughout much of the afternoon, reaching hurricane velocity about 1 p. m., and the center of the storm appears to have passed Belize about 3:30 p. m. Some details, excerpted from a report made by D. A. Fairweather, Government wireless operator at Belize, follow:

> The wind began to increase about 11 o'clock from the northeast and by 12:40 p. m. had reached a velocity of 48 miles an hour.
>
> At 1:15 p. m. the velocity was 60 miles and the barometer registered 28.10. Between 1:35 and 2:00 p. m. the wind lulled to 38–48 miles returning to 60 miles an hour at 2:05 p. m. from the north. It crept up to 72 miles an hour at 2:15 p. m., 96 miles at 2:30 p. m., 120 miles at 2:45 p. m. and maintained a velocity of 132 miles an hour from 2:50 to 3 p. m. At 3:05 p. m. the wind dropped to 72 miles and finally to about 12 miles.
>
> At 3:44 p. m. the wind shifted to the southwest and rose suddently to 80 miles an hour. The anemometer gave way at this juncture.

The winds swept the sea forward over the environs of the port, which is built on exceedingly low ground, choked the mouth of the Belize River with the wreckage of small boats, including six Honduran schooners, piled a 200-ton dredge upon the wharf, and with wreckage as battering rams, smashed into the structures of the town itself. It was a disaster of major proportions, entailing a loss of life that is not definitely known, but probably exceeding 1,500 souls, and a property loss that was estimated in later dispatches at $7,500,000.

Meanwhile, the third storm of the month was raging as a hurricane over the Gulf of California. As noted above, this storm probably began on the 6th, and was first reported by the American steamer *Marian Otis Chandler*, Captain Sawyer, which encountered a variable to east-northeast gale of force 8, with a lowest barometer of 29.67 inches, in latitude 16° N., longitude 98° W. If so, however, there is a gap in the storm history, owing to lack of reports, for it next appears on the afternoon of the 9th, when, at 8 p. m., the Dutch motorship *Drechdijk* encountered an east-southeast gale of force 8 near 19° 30′ N., 105° 35′ W., followed by conditions which indicated that the disturbance was passing to the northwestward.

A maximum wind of force 10, prior to the regular a. m. observation at the Mexican weather station at Manzanillo, with barometer reading 29.68 inches, marked the position of the disturbance to westward of that station on the morning of the 10th. On the morning of the 11th the British steamer *Astronomer* encountered the storm about 20° 30′ N. and 107° 30′ W. The further progress of the hurricane appears in the report of the American steamship *W. S. Miller*, which experienced a southeast hurricane near 23° N. and 108° W., and barometer down to 29.4 inches, at 9 p. m. of the same date. This was the first report to show that the storm had developed full hurricane intensity.

Late on the afternoon of the 11th the French steamer *Korrigan III*, lying in port at La Paz, Lower California, experienced the preliminary northeast gales of the approaching hurricane. The report of the first officer R. Moya of the *Korrigan III*, Capt. S. Meza, furnished to Mr. E. W. Easton, American vice consul at Mazatlan, Sinaloa, gives definite information as to the severity of the storm in this vicinity. By 2 a. m. of the 12th the wind in the harbor of La Paz was blowing with force 12 from the north, and the pressure was falling. At 3 a. m. the reading of the barometer on the *Korrigan III* reached 28.74 inches, followed for some minutes by greatly diminished wind. At 3:35 a. m. the wind came from the south and soon rose to force 10, as the hurricane center passed.

There was no great damage in La Paz as the hurricane passed, but with its further movement up the peninsula of Lower California, on the morning of September 12 it caused the American steamship *Colombia* to go aground on Santa Margarita Island as she became involved in the winds and possibly the unusual currents attending the hurricane's progress. This ship, a passenger liner en route from New York to San Francisco, carried 234 passengers and crew, all of whom were safely removed through able seamanship of the officers of the stranded vessel and the rescuing ship *San Mateo*, of the United Fruit Line. There was hope at first that the ship might be salvaged, but continued heavy weather prevented, and the vessel, abandoned on the 13th, broke up under stress of the seas developed during the following week by

the succeeding storm movement. More than $150,000 in gold and silver, carried by the *Colombia*, was later recovered, but the remainder of the cargo, including personal belongings of the passengers, seems to have been a total loss.

As the hurricane moved farther northward it was reported in press dispatches to have caused exceedingly high tides on the 13th at Guaymas and Santa Rosalia, Mexico, with approximately 50 lives lost by drowning in the 9-foot inundation of the latter town. From this point the storm seems to have diminished and dissipated, probably moving inland over the State of Sonora.

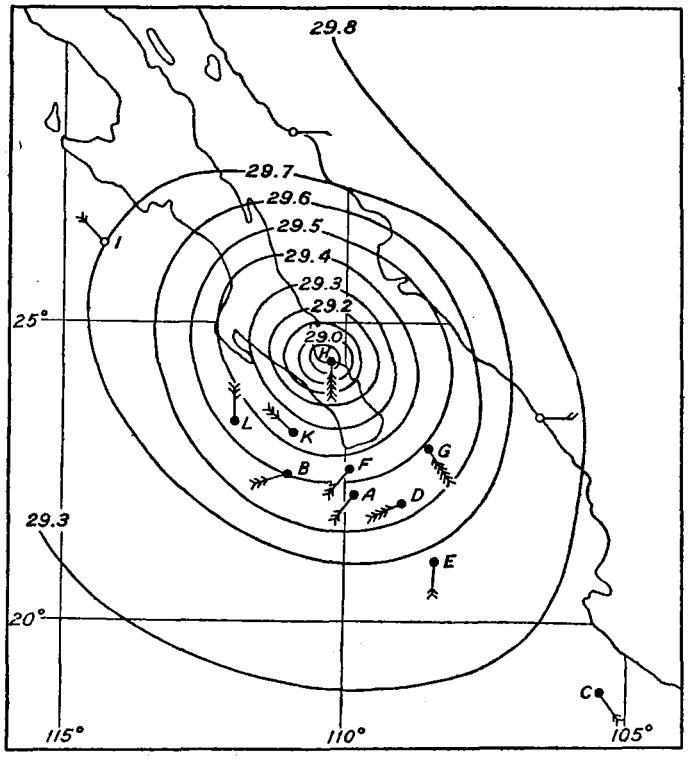

FIGURE 1.—Observations from vessels and near-by coast stations in the hurricane of Sept. 12, 1931, at Greenwich noon. Storm center just west of La Paz. Letters signify the following vessels: *A*, American steamer City of Elwood; *B*, American steamer Sea Thrush; *C*, British steamer Astronomer; *D*, American steamer San Raphael; *E*, American steamer Chattanooga City; *F*, American steamer Muntropic; *G*, American steamer W. S. Millie (position approximate); H, French steamer Korrigan III (4 a. m. in port at La Paz); *I*, American steamer President Van Buren; *K*, American steamer San Felice; *L*, American steamer Nebraska.

The wind and barometer conditions reported from several vessels caught in this storm on the early morning of September 12 (about Greenwich noon) are charted in Figure 1 to indicate the location and intensity of the hurricane at that time.

The fourth of the seven storms originating in September, first reported over the waters north of the Leeward Islands on the 9th, passed Porto Rico as a small but well-developed hurricane on the night of the 10th–11th. A report of its movement along the north coast of Porto Rico and of its characteristics at that time will be found elsewhere in this issue. The next definite report of its progress is from the Honduran steamship *Alegria*, which was in harbor at Port Antonio, Jamaica, on the 12th, and experienced typical hurricane conditions with wind shifting from northeast to southeast and of force 8 to 11 during that afternoon, but without extreme depression of the barometer.

Only one further gale report is at hand for this storm as it continued to travel due westward across the Caribbean Sea, namely that from the American steamship *Cartago* which reported a moderate gale, shifting from east-northeast to southeast, in 19° 25′ N., 85° 50′ W., early on the 14th. After this date the disturbance moved on across Yucatan and evidently into the lower Gulf of Campeche, finally passing inland over or near the city of Vera Cruz at 4 a. m. of September 16.

A special report received from Ing. Ernisto Dominguez, in charge of the meteorological observatory at Vera Cruz, gives the following facts: Preliminary evidences of the approach of the hurricane became unmistakable on the 15th, with a moderate northerly wind, increasing without a rise but rather a fall in the barometer. By afternoon the wind became gusty and was sufficiently strong by nightfall to make it necessary to close the port. By midnight the violence of the wind had risen to near hurricane force with the barometer dropping decidedly after 10 p. m., but the direction of the wind continued rather steadily from the north-northwest up to the time of barometric minimum, 29.43 inches, about 4 a. m., at which time there was a shift to east-northeast, indicating that the center of the disturbance moved inland to the south of the observatory.

The clouds were overrunning the surface wind, however, at 2 a. m., being from an easterly direction already at that hour. With the shift of the surface wind to easterly just before 4 a. m., there was an increase in force, and the maximum velocity was attained a little after 5 a. m., when 42.5 m. p. s. (95 m. p. h.) was recorded. The report states that this velocity established a record for Vera Cruz.

There appears to have been no damage of great consequence in the city of Vera Cruz, but news dispatches reported the loss of a number of small ships outside of the harbor, the largest of which was the 800-ton Mexican steamer *Dos Equis*, which sank with all hands lost, including a number of passengers.

This was the third and last storm movement of the month on the Atlantic side of the continent, with but one storm previously occurring on the Pacific coast. Before the Vera Cruz hurricane had crossed Yucatan, however, the second Pacific cyclone and the fifth tropical storm development of the month was in progress.

This cyclone closely followed its predecessor of a week before, appearing near 15° N., 100° W., early on the 14th, but it failed to develop the intensity of the first Pacific storm. At 8 a. m. of the 15th the American steamer *Willboro*, near 18° N., 104° W., met with a southeast gale of force 10, the highest noted for the storm. The lowest barometer reading reported was 29.54 inches, from the American steamer *San Felipe* in 17° 45′ N., 103° 25′ W., at 4 p. m. of the 14th. The last gale reported in connection with the storm was of fresh force and occurred near 20° N., 106° W. on the 17th. Thereafter the disturbance, as indicated by reports, seems to have been of slight force, yet it is quite possible that its accompanying seas were sufficiently rough to cause the final breaking up of the *Colombia* between the 18th and 20th.

The last two developments of the month, both in the Pacific, apparently originated in the same locality, about three or four hundred miles south of Acapulco, Mexico, and moved northwestward, approaching the peninsula of Lower California, to lose themselves finally by passing inland over extreme northwestern Mexico.

The earlier of the two and the sixth tropical disturbance of the month in American waters was first shown by observations on the 20th, when the British motor ship *Seminole* reported a barometer of 29.64 inches and fresh east gale near 17° 43′ N., 103° 19′ W. On the 21st the American steamer *Suriname* had a strong gale from ESE. near 19°

N., 106° W. On the 22d the steamer *New Jersey* had a strong southeast gale near 21° N., 108° W., barometer depressed to 29.49 inches. On the 23d the steamer *Steel Age* had a southeast gale of force 11 near 23° N., 111° W., barometer 29.26 inches. On the 24th the steamer *Robin Hood* had a strong southeast gale near 25° N., 113° W. Thus, was shown the northwestward progress for five days of a storm that was at least of near-hurricane force off the west coast of Lower California.

The seventh cyclone was first indicated by reports as organizing on the 26th in the vicinity of 17° N., 103° W. It probably attained the height of its energy on the 27th, during which day the steamship *Willkeno* had a whole gale from ESE., barometer 29.60, near 19° N., 105° W., and the steamer *Charles R. McCormack* encountered strong northeast to southeast gales near 19° N. 106° W., with a maximum force of 12 from ESE. at noon, lowest pressure 29.13 inches. Captain Christensen of this vessel said the storm was accompanied by the heaviest precipitation of his experience. The storm proceeded northwestward with apparently lessening energy and was last heard from in connection with a moderate easterly gale on the 29th at about 23° N., 110° W.

BUCKET OBSERVATIONS OF SEA-SURFACE TEMPERATURES

By GILES SLOCUM

STRAITS OF FLORIDA AND CARIBBEAN SEA

Table 1 shows the average temperatures for the Caribbean Sea and the Straits of Florida for September of each year from 1919 to 1930, inclusive, and Table 2 summarizes the temperatures for September, 1930, in the same areas. The chart shows the number of observations taken in September, 1930, within each 1° square and mean temperature data for subdivisions of the area considered.

September is the warmest month in the Caribbean Sea, with the mean yearly peak in temperature occurring at approximately the end of the month. The Straits of Florida, while usually cooler in September than in August, are warmer than in July, and the temperatures there drop but slowly until the final days of the month, when the abrupt autumn drop in temperature ordinarily commences.

The last quarter of September, 1930, was slightly cooler than the 11-year mean in the Caribbean, but the month as a whole was warmer than the average, the seventh consecutive month of high temperatures. The Straits were close to the seasonal average in temperature, except in the final quarter, when they were above the mean.

TABLE 1.—*Mean sea-surface temperatures in the Caribbean Sea and the Straits of Florida for September, 1919–1930*

Year	Caribbean Sea		Straits of Florida	
	Number of observations	Mean (°F.)	Number of observations	Mean (°F.)
1919 [1]	87	82.6	28	82.2
1920	192	82.2	35	83.3
1921	255	82.1	104	83.4
1922	150	82.2	66	83.0
1923	237	82.0	71	83.1
1924	310	83.4	79	83.7
1925	384	82.7	131	83.6
1926	429	83.3	149	83.5
1927	547	83.6	180	84.3
1928	597	82.9	156	83.6
1929	644	82.5	176	82.8
1930	588	83.0	175	83.5
Mean (1920-1930)		82.7		83.4

[1] Not used in computations because of insufficient data available.

TABLE 2.—*Mean sea-surface temperatures (° F.) and number of observations, September, 1930*

Quarter	Period	Caribbean Sea				Straits of Florida			
		Number of observations	Mean	Departure from 11-year mean (1920-1930)	Change from preceding month	Number of observations	Mean	Departure from 11-year mean (1920-1930)	Change from preceding month
			°F.	°F.	°F.		°F.	°F.	°F.
First	Sept. 1-7	141	83.1	------	------	38	83.5	------	------
Second	Sept. 8-15	169	82.9	------	------	51	83.4	------	------
Third	Sept. 16-22	137	83.2	------	------	35	83.6	------	------
Fourth	Sept. 23-30	141	82.6	------	------	51	83.5	------	------
	Month	588	83.0	+0.3	+0.5	175	83.5	+0.1	−0.8